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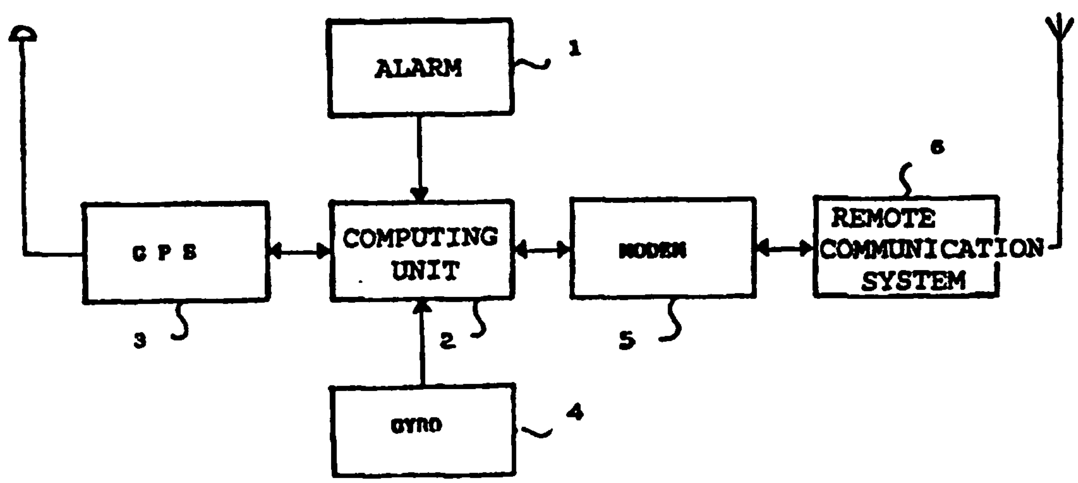

(57) Abstract

The system for locating moving vehicles or objects comprises on board the "target" a system for determining geographical position such as a rig known as Global Positioning System (GPS); a secondary system for determining the position of the target based on a gyroscope arrangement; a system for remote communication such as a cellular telephone system (GSM); a computing unit coupled through a modem to the system for remote communication. Furthermore, it comprises on board the "seeker" a system for determining geographical position such as a Global Positioning System (GPS); a secondary system for determining position, based on a gyroscope system; a computing unit; a display system for providing the seeker with search information; an archive of preset geographical positions (geographical map), a system for remote communication such as a cellular telephone system (GSM).

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System for locating moving vehicles or objects

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The present invention relates to a system for locating moving vehicles or objects.

More particularly, the present invention relates to a system of the aforesaid type which comprises a rig on board the vehicle or object whose position within a geographical area it is intended to determine, and a locating rig placed with a person performing the search, for example on board a "seeker" or "pursuer" vehicle.

Systems for locating objects, vehicles, persons remotely using radio means are known in principle for air, sea and land use.

Navigation systems are also known for use in the air, at sea and on land on board motor vehicles for the continuous determination of "geographical fix".

The purpose of the present invention is to provide a system of the abovementioned type adapted in particular to the locating of vehicles appropriated from the control of the owner which enables the owner or someone on his behalf to pursue and locate the appropriated vehicle within a definite geographical area.

For convenience of description, the vehicle on board which is placed a first part of the rig, and which could be appropriated or anyway could assume a geographical location which is not known a priori, will be termed the "target" and the vehicle containing the remainder of the rig, racing to locate the target, will be identified in short as the "seeker".

According to the present invention there is provision to arrange on board the target a system for determining geographical position such as a rig known as Global Positioning System (GPS); a secondary system for determining the position of the target based on a gyroscope

arrangement; a system for remote communication such as a cellular telephone system (GSM); a computing unit coupled through a modem to the system for remote communication; and arranged on board the seeker a system for determining geographical position such as a Global Positioning System (GPS); a secondary system for determining position, based on a gyroscope system; a computing unit; a display system for providing the seeker with search information; an archive of preset geographical positions (geographical map), associated with the computing unit and a system for remote communication such as a cellular telephone system (GSM).

The present invention will now be described with reference to a currently preferred embodiment thereof, given by way of non-limiting illustrative example, and based on the figures of the appended drawings in which:

Figure 1 shows the general block diagram of the arrangement of the rig part on board the target;

Figure 2 shows the general block diagram of the rig part on board the seeker;

Figures 3A and 3B show diagrammatically a possible structure of the device on board the seeker vehicle;

Figure 4 shows diagrammatically the flowchart of the software resident in the computing unit on board the target;

Figure 5 shows diagrammatically the flowchart of the software resident in the computing unit on board the "seeker";

Figure 6 shows an example of the graphics on a display available to the seeker; and

Figure 7 shows an example of the display of the bearing angle of the seeker with respect to the target with reference to a representative geographical map.

With reference to the drawings and in particular to Figure 1, arranged on the target is a system comprising an alarm device 1 such as for example an anti-theft system in the event that the target is a motor vehicle.

The alarm device 1 is connected to a computing unit (CU) 2, which is disposed for starting up the whole of the system following the detection of an alarm condition such as a theft or an unauthorized use of the vehicle.

A rig for locating geographical land fix such as a "Global Positioning System" or GPS rig, indicated as 3, is connected to the computing unit 2.

These GPS rigs devised for military purposes are now widespread within the civil sphere and are based on the reception of signals from a number of satellites forming part of a constellation of satellites orbiting the earth. These rigs can provide the geographical fix and also the absolute altitudes with respect to sea level with medium/high accuracy for civil uses.

The accuracy of determination of the geographical fix can be increased enormously if the GPS is made to operate in "relative" mode, as is well known to those skilled in the art.

Their only drawback is that the acquisition of data for the determination of position is relatively slow.

The computing unit 2 is also associated with a gyroscope system (GYRO) 4 for immediate detection of variations in the direction of travel of the target vehicle which are communicated to the computing

unit 2. Preferably, the gyroscope system 4 is fitted with a solid-state "rate gyro" based on the Coriolis effect and marketed by the Japanese company MURATA.

The computing unit 2 is furthermore connected through a modem 5 to a system 6 for remote communication. The system 6 can be a straightforward radio transceiver or a cellular telephone. In the latter case, a cellular telephone system of the GSM type is preferred on account of the ease of interfacing between GSM cellular telephone and modem 5.

The system now described is permanently linked to the battery of the vehicle and is furnished with its own emergency power supply which guarantees its operation.

Under normal conditions both the GPS subsystem 3 and the GYRO subsystem 4 and also the computing unit 2 are active.

The GPS 3 and GYRO 4 subsystems continuously compute the geographical position of the target vehicle in which they are installed and communicate this to the computing unit 2 updating it, for example, once a second.

Every second, the computing unit 2 stores the new position datum, constantly checking on the input of the alarm device 1 for the existence of conditions which require the transmission of the position data to the seeker device which will be described below.

The remote communication system 6 with which the CU 2 is associated is on standby for calls. The computing unit 2 furthermore has a non-volatile memory device in which several telephone numbers are recorded.

On the occurrence of an alarm condition, the CU 2 cyclically calls the telephone numbers contained in the non-volatile memory until a connection is established with one of them.

At this point it sends an alarm message and the most recent information available to it on the position of the vehicle.

On termination of the alarm message, the CU 2 places itself on standby for a confirmation message for a programmable time X, on the occurrence of the "Time out" conditions, the alarm message is repeated. If the communications are interrupted before reception of the confirmation message, the call sequence is repeated.

On reception of the confirmation message, the target device interrupts the communications and places itself on call standby, continuing with position computation, as already described.

With reference to Figure 2, the device on board the seeker comprises: a GPS system 7 similar to that mentioned with reference to Figure 1; a computing unit 8 connected to a display 9; a gyroscope device 10 similar to that mentioned with reference to Figure 1; an archive of known positions 11 preferably in the form of an interchangeable memory module; a modem 12 and a remote communication system such as a GSM rig as explained with reference to Figure 1.

Given the similarity between the target device and the seeker device, a detailed description of the latter will be omitted.

The operation of the locating system according to the invention in a search operation will be described below.

The seeker device can locate any target device so long as it knows its telephone number. Under normal conditions this device is activated as soon as it is removed from a recharging cradle of the motor car, well known per se, whilst it remains active when inserted into the

recharging cradle arranged in the fixed spot at which the seeker is sited in the rest or standing-by to intervene condition.

If the vehicle is abandoned by the driver with the seeker on board, a strong acoustic warning signal is brought into operation.

Similarly, a strong acoustic signal is emitted also in the event that the motor car is abandoned by the owner somewhere outside of the coverage of the GPS or GSM signal.

In the event that the seeker receives a call from the target, it then activates the devices for determining its own position, receives and stores the position of the target vehicle and, when it is certain of the reliability of the datum received, sends the confirmation message to the called target.

When the actual GPS device has computed the position of the seeker, the direction with respect to true North (bearing) to be taken in order to reach the target is computed and flagged in the form of an analog compass. This information is provided and flagged in degrees.

Furthermore, the GPS device consults its own internal archive and the position of the target with respect to the nearest town (distance and bearing), or to the nearest district in the case of a city, is indicated.

At this point the manager of the seeker procures the means adapted for the pursuit and location of the target and, on beginning the pursuit, will call the target via the seeker.

When the two devices are once again in mutual communication, the seeker receives, every second, the positional data of the target and hence has the possibility of computing and highlighting the following information using its own position and the archive of known positions 11;

- the seeker and the vehicle carrying it are provided for, respectively oriented in the direction of travel, in the top quadrant of the software-constructed satellite analog compass, in which at 12 o'clock is marked an asterisk to indicate the direction of movement of this seeker. True North is thus also marked on the quadrant together with the bearing of the target in the form of an arrow which in the search movement always indicates the direction of the target with respect to the seeker;

- the updated position with respect to the nearest town or district is found;

- the distance in metres to the target is computed and kept constantly updated (Great-Circle course); and

- visual and acoustic indication is flagged of target approaching, target receding and target dead ahead.

The acoustic signal is programmable, it being possible to adjust:
in respect of the target

-

last date and time received from the target,
number of satellites visible from the target,
- geographical position of the target in degrees, minutes and seconds,
- elevation of the target,
- speed of the target,
- course of the target
- state: Navigation/Acquisition/Gyro; in respect of the seeker
- current date and time on the seeker,
- number of satellites visible from the seeker,
- geographical position in degrees, minutes and seconds of the seeker,
- elevation of the seeker,
- speed of the seeker,

- course of the seeker,
- state: Navigation/Acquisition/Gyro.

The state of the radiocommunications is likewise monitored and checked.

Cutting of the connection gives rise to automatically repeated calls until normal communications are resumed.

Shown diagrammatically in Figures 3A and 3B is a possible external appearance of the seeker device.

This seeker device is in the form of a computer 20 of the "Lap Top" type comprising provision for a mass memory module 21 which carries a store of the positions relating to the towns in Italy, either on a global scale, or on a reduced scale, according to need.

The screen 22 of the computer 20 displays information as indicated more systematically in Figure 6. It should be understood that the modes of presentation of the information are given wholly by way of example for greater understanding of the present invention and do not constitute part of a property right.

Considerations regarding the advantages of the system according to the present invention will now be discussed.

To furnish vehicles of value (or which transport valuables), with a means which allows their rapid recovery in the event of misappropriation is the objective which many have set themselves in more or less recent times.

Activation of the so-called GPS system has meant that many concerns have designed and developed various devices based on this system. This notwithstanding, there are many difficulties with the construction and management of systems of this type. These can be

traced back to considerations regarding management costs, mapping and communications.

The systems currently in use in fact utilize an operations centre manned around the clock by an individual watching the monitor of a computer for the raising of an alarm. This computer needs to be furnished with electronic mapping to allow the pinpointing of the position of the vehicle from which the alarm emanated, moreover, the individual on watch needs to be able to employ a vehicle, their own or from the forces of law and order, in the search for the appropriated vehicle, directing the recovery operations by radio or cellular telephone.

It is at once obvious that such a system currently in use envisages, up to the moment at which the first vehicle attends, the facility of the operations centre and the use of digital mapping. Moreover, the facility of the operations centre involves very high costs of manning, machinery, logistic set up, etc., and the adoption of digital mapping entails, apart from the intrinsic inaccuracies, high purchase and maintenance costs.

Moreover, mapping of many large, medium-sized and small cities, to say nothing of villages, is not yet available and will not be so for quite some time.

Another problem connected with the currently available national mapping derives from its non-compliance with the WGS 84 (World Geodetic System 1984) reference system used by the GPS satellite system.

The system described above obviates the aforesaid drawbacks, that is to say the costs due to the operations centre and to the mapping, insofar as neither the one nor the other is required.

Thus, the seeker device is of very low cost which, considering the economies of scale of mass production, may amount to just a few hundred dollars. Such a device moreover allows autonomous searching by the owner of the vehicle or assisted by the police.

It should also be noted that the seeker device provides data directly referred to the target vehicle in real time, such as the distance in metres, the direction, the speed, the exact geographical position, the nearest town, etc. The position data can, if desired, be transferred to a common mapping allowing subsequent display.

It should further be noted that the data relating to the great-circle distance (shortest path between two points on the earth's surface), the bearing angle or direction, etc. provided by the system according to the invention, are to be regarded as exact insofar as both the seeker device and the target device use the same WGS 84 reference system.

By way of further clarification, some hardware characteristics of the sub-assemblies making up the system according to the present invention will now be illustrated.

The GPS system is one which makes it possible to compute the position of any point on the surface of the earth with high precision. The average approximation is usually between 25 and 50 metres but can be reduced if suitable computing techniques are used. It will be assumed that this precision is sufficient in the application of the system according to the invention.

Computation of position is performed using three or four satellites, each of which provides a distance value. By applying a system of equations in four unknowns, three for the coordinates X, Y, Z and the fourth C for the clock and solving by Taylor's method, the required solution for the position is obtained. Corrections for relativistic effects, ionospheric and tropospheric distortion are then applied in the known manner. The position is provided by the processor installed on the

standard GPS Board in several formats such as the Cartesian coordinates in meters from the centre of the earth and the geographical coordinates, that is to say latitude and longitude in radians.

Much other information is furthermore obtained from the same processor, such as:

- date and UTC time (Universal Time Coordinate equivalent to GMT Greenwich Mean Time),
- altitude in metres,
- number and identifiers of the satellites used,
- data concerning the accuracy,
- various correction factors,
- state of the receiver.

This last item of information is useful in that it makes it possible to decide if and when to pass from the main position determining system, that is to say that based on GPS, to the secondary system (GYRO).

It should be pointed out at this juncture that the system provides the values of Cartesian or geographical coordinates referred to the WGS-84 ellipsoid which is the model adopted by the United States.

All the information deduced by computation of the CU and that provided directly by the GPS system are therefore also referred to WGS-84.

The device described earlier in a currently preferred embodiment thereof, uses the latest version of GPS Board produced by Rockwell U.S.A., which is capable of providing the first position after about 60 seconds from go. The information is presented on one of the serial ports of the computing units.

The GYRO subsystem intervenes on request from the computing unit as backup device for the determination of position when, for various reasons, GPS loses the ability to navigate and enters a defined "acquisition" state, which can occur essentially because the antenna is obscured by tunnels, other buildings, foliage, etc.

The GYRO subsystem provides the computing unit merely with variations in the angular velocity of the vehicle on which it is placed. These data are easily obtainable from a miniaturized instrument marketed under the name Gyrostar® produced by the Japanese company MURATA.

The Gyrostar® is connected to an A/D (analog/digital) converter which in turn offloads the angular velocity variation data onto the port of the computing unit at a sampling frequency of for example 50 data per second.

In the absence of position data provided by GPS it is therefore possible to compute new positions with the data from Gyrostar® if the value of the velocity is also available.

This latter data item can be obtained directly from the car on which the target device is sited, although this involves a complication in the mounting of the target device on the vehicle, in addition to the fact that the velocity information cannot be obtained from all types of cars in the same way and that the seeker device in turn cannot avail itself of a direct information item regarding velocity.

In view of the above and the fact that the intervention of the GYRO system has to be limited in time since the "dead reckoning" navigation techniques are intrinsically imprecise, the velocity value used in computing the position is provided by the software which always has access to the mean velocity for the last 60 seconds.

The position computed with the GYRO system should therefore be regarded as indicative for maintaining an acceptable space-time correlation between the target and the seeker during GPS blackout.

However, if GPS blackout were required to exceed two/three minutes it would be advisable for the seeker to go to an open spot from which the actual GPS can again deliver correct position values.

If conversely the GPS blackout is on the target, the seeker will receive this information, showing the "GYRO" status on the display.

It will be up to the operator in charge of searching for the appropriated vehicle to assess the situation and, depending on the distance to the target and on its direction, he will adjust his own behaviour.

According to a preferred embodiment, the computing unit adopted by the target device consists of INTEL 286/386 or equivalent µPs fitted out with the circuitry required to manage three RS232-C serial ports and two Centronics parallel ports, without any other special features.

The computing unit adopted by the seeker device furthermore provides for a PCMCIA type memory card flash driver and a type 1/4 VGA back-illuminated liquid crystal display driver. The operation of the computing unit is described in the particulars of the on-board software.

Diagrammatically illustrated in Figures 4 and 5 are the flowcharts respectively of the software resident in the computing unit on board the target and of the software resident in the computing unit on board the seeker.

The features of these two items of software will be discussed below without entering into the detailed description of the individual blocks depicted in the flowcharts, since their concatenation is immediately inferable by those skilled in the art.

The software subsystem complies with the same splitting into two components as already examined in detail for the hardware.

There is in fact seeker side software and its target counterpart.

Before examining the functional microanalysis in detail, a macrodescription will be given of the functioning which characterizes the system.

The target continually computes its own position, keeping track of the latest reliable position, the mean velocity for the latest minute, for the latest quarter of an hour and for the latest hour. As it continues to "cycle" it carries out some checks such as:

the presence of incoming calls;

the presence of the alarm system (in the widest sense);

the proximity to "danger" zones.

The occurrence of one or more of the above events allows the despatching of the data relating to its own position by the target to the seeker, which works only if called by a target or if a target's call function is activated.

In both cases the data received from the target are compared by the seeker with those received from its own GPS subsystem and the results of this comparison, whether in digital or analog form, are flagged in the display of the seeker.

It will furthermore be noted that as far as the target is concerned the following particulars are complied with:

- in the case of incoming calls, the target will verify, through the sending by the seeker of a ten-digit keyword which constitutes the

permission by this seeker to talk, for the purpose of preventing other seekers or other users of a seeker from being able to have recourse to the system. The keyword is preferably composed of a five-digit prefix characteristic of the seeker hardware system and of a five-digit suffix characteristic of the operator;

- the expression activation of the alarm system is understood to mean that the computing unit of the target will be able to interface with one or more communication channels (parallel/serial ports, I/O interfaces) dedicated to the alarm system (or systems);

- the expression approach to danger zones is understood to mean the comparison between positions occupied by the target for more than 5 minutes, which would fall within areas recorded in the non-volatile memory of the target. 64 such positions are provided for and within a 5 km vicinity each of these points is regarded as a "danger zone". Purely by way of example, the following may be regarded as such; frontier crossings, harbours or airports; and

- the data which are transmitted (and received) travel, however, in encrypted form, the algorithm for which is known only to the constructor.

Both the GPS system and the modem used to transmit/receive data are connected to a serial port (RS232c) of the computing unit.

The mechanism for communicating between the processor and the units connected to the serial ports is with interrupt: examination of the state of the ports is not therefore sequential but, at any moment, the computing unit can be interrupted in its own calculations so as to cope with the requests originating from the serial ports.

The priorities of the two peripherals are identical but neither of the two can interrupt the other if currently executing; in other words the calculation connected with the modem must be terminated before

being able to satisfy any request originating from the GPS and vice versa.

As regards the target and related initialization, the internal database is read, it being composed of the data relating to the danger areas, the "time out" for the calls of the seeker, the telephone numbers to be selected, the seeker and operator codes permitted to communicate with the target, the configurations of the modem and the maximum time of stay in danger zones.

The computing unit executes the test of the GPS by sending a suitable message (message code 202 for the request to the GPS and message 101 for the response concerning the results of the test).

If the result of the test is negative, the procedure for communication with a seeker is activated immediately. As soon as the communication channel is activated, a suitable message 27 of failure of the operation of the GPS is sent. After sending this message and receiving the response message 07, the GPS is deactivated and the system remains on standby.

If the result is positive, calculation continues and configuration of the modem is undertaken, concomitantly with the test of correct operation of the modem. If the result is negative, it actually becomes impossible to communicate; from this moment onwards the computing unit will keep track in rows of the positions occupied until the reserves of the memory peripheral units are refilled, discarding the oldest data and recording the most recent, so long as they are reliable and are characterized by a velocity greater than 5 km/h, that is to say by means in motion.

Hence, the target will cycle continuously until one of the following conditions obtains:

the presence of arriving calls;

the activation of the alarm system;

the proximity to "danger" zones.

In the first case the module which is dealing with the communications takes control of the computing unit after having ascertained the presence of the ringing telephone, and orders the handset to be lifted and handshaking to be set up.

Once the communication is connected, the admissibility of the incoming call is checked: the target places itself on standby for data and in particular for the message 01. This message contains the machine code of the seeker and that of the operator.

If the check on the codes is positive, the communication can continue: in this case the message 21 is despatched.

Otherwise the computing unit orders the modem to replace the handset, interrupting the communication.

In the second case, should the signal present on the parallel port become ON and remain so for 10 seconds, the communication procedure is activated.

In the third case, to determine entry into danger zones, a counter is activated every time the point computed by the GPS subsystem lies within a 5 km radius of one of the points loaded in the initialization phase.

If the counter reaches the value defined in the initialization phase, for example currently defined as 5 minutes, the procedure for communication with the seeker is activated automatically.

If the order to activate the communication procedure issues from the target, there will be no check or exchange of messages of recognition via software.

The communication procedure consists in dialling up in order, as they are listed in the initialization phase, the stored numbers; with each telephone number will be associated the number of attempts to be made before passing to the next. The exchange of data will take place with the first seeker with which communication is successfully established.

However, the seeker sending the message 02 can order the target to communicate only with a particular telephone number; having received this message, the target confirms reception by sending the message 22.

Before beginning to transmit the data related to position, the target transmits the message 21 relating to its own identifier data, in addition to the UTC time available with the indication of whether or not this is a valid time.

Normally, communication takes place with the message 23 which contains the data relating to position, UTC time, velocity, course, elevation and state of the GPS receiver.

The seeker responds by in turn sending a message 03 which is basically just a confirmation of receipt of the message 23 having taken place.

After sending the message 23 and receiving confirmation of receipt, the target suspends communications, on receipt of the message 04 and places itself on standby for other calls, in turn sending a message 24 for confirmation.

In the event of receiving the message 05 it will respond by sending the message 25 relating to mean data on the velocity computed within the latest minute, quarter of an hour and hour.

As regards the seeker and related initialization, the internal database is read first of all, consisting in loading the positions of the towns, the seeker's own code and the configurations of the modem; the password is then requested from the operator assigned to the use of the seeker.

The computing unit executes the test of the GPS by sending a suitable message (message code 202 for the request to the GPS and message 101 for the response concerning the results of the test).

If the result of the test is negative, the operator is immediately notified via a message on the display of the non-functioning of the GPS.

If the result is positive, calculation continues and the configuring of the modem is undertaken, concomitantly with the test of correct operation of the modem. If the result is negative, so that it in fact becomes impossible to communicate, the operator is immediately notified via a message on the display of the non-functioning of the modem.

The operator can activate the system in order to communicate with a target or await the arrival of a call.

In the first case, the number of the target to be called is requested from the operator: once the number is typed in, the computing unit instructs the modem to dial up the number in order to attempt to establish the connection.

Regarding an incoming call, the target will wait for the arrival of the message 01 and then, after having verified active connection, the seeker will have to send, through the aforesaid message, its own machine code and that of the active operator.

After this it will place itself on standby for a message 21 unless the communication is cut on the volition of the target.

Once the message 21 is received, it will place itself on standby for subsequent messages of type 23, comparison between these data and those gleaned directly from its own GPS subsystem will enable the computing unit to flag on the display the information relating to distance and to bearing.

In the second case, calculation will proceed as soon as the modem notifies the computing unit of the presence of an incoming call, which will follow the instruction to the modem to lift the handset and establish the communication.

From this moment onwards the behaviour will be identical to that described above.

The seeker synchronizes what it received through the message 23 with the information received from its GPS subsystem, and which will make reference to the same UTC time.

The seeker stores two series of tracked points. The first series is the set of pairs of synchronized points <target(t), seeker(t)>, t standing for the generic instant at which both coordinates are available; the frequency of storage is one point every 30 seconds and relates to the last 30 minutes of navigation.

The second series, however, relates solely to the path of the seeker, a point, if dependable, being stored in any case every 10 seconds.

It will be possible to flag both series in vector form on the display for the purpose of providing useful information to the operator about the path followed and/or to be followed.

The positions and the distances to the nearest localities will also be flagged in the display phase, after having effected a comparison with the positions registered in the database.

If the connection fails, this being determined through the lack of confirmation of reception sent by the seeker to the target, the communication is reestablished by the same system which had activated it.

The seeker can determine in the target a particular configuration of its GPS subsystem, that is to say it can indicate which satellite to use or which elevation to use and to do this it uses the message 06. The target confirms with the message 26.

The position information is normally received by a GPS type multichannel circuit, although it sometimes happens that particular local conditions, such as buildings, foliage, mountains, do not allow visibility of a sufficient number of satellites to compute a position. Therefore, both the target system and the seeker system avail themselves of a fibre optic or piezoelectric gyroscope circuit which makes it possible, as stated, to compute position even if with the passage of time the effect of precession renders a data item gleaned in this way less accurate.

Nevertheless, it should be borne in mind that the intervention of this circuit is to be regarded as necessary only for short intervals of time of the order that is of a few minutes, this maintaining the error due to precession within acceptable limits.

In each case the seeker is informed about the status of all the circuits for computing the position, both of the target and its own ones.

Simply pressing a button on the seeker enables plots of the target and seeker paths to be displayed.

Presentation is on a variable scale in accordance with the order of magnitude of the distances and with true North at 12 o'clock. Pushing the same button again causes a return to the previous display.

The accuracy of the position determination is variable but may be considered constant with an error of between 25 and 50 metres.

For the recovery of vehicles the manager of the seeker follows the indications of the satellite compass and constantly checks that the value of the distance to the target is decreasing. Having reached a distance of about 100 metres from the vehicle, if it has not yet been sighted, the manager of the seeker pushes a button on the seeker which activates at the target a loud acoustic alarm which signals the vehicle. Finally, for system security, the data can be transmitted by the target only after the sending of a password which enables the seeker to be identified unambiguously.

The present invention has been described with reference to a currently preferred embodiment thereof, but it will be understood that variations and modifications may be made in practice by a person skilled in the art without departing from the scope of protection of the present industrial patent right.

CLAIMS

1. System for locating moving vehicles or objects characterized in that it comprises on board the "target" a system for determining geographical position such as a rig known as Global Positioning System (GPS); a secondary system for determining the position of the target based on a gyroscope arrangement; a system for remote communication such as a cellular telephone system (GSM); a computing unit coupled through a modem to the system for remote communication; and arranged on board the "seeker" a system for determining geographical position such as a Global Positioning System (GPS); a secondary system for determining position, based on a gyroscope system; a computing unit; a display system for providing the seeker with search information; an archive of preset geographical positions (geographical map), a system for remote communication such as a cellular telephone system (GSM).

2. System according to Claim 1, characterized in that the rigs on board the target are activated, in the case of installation on board a motor vehicle, following the triggering of an anti-theft alarm device or of a system for detecting unauthorized use of the vehicle.

3. System according to one or more of the preceding claims, characterized in that the computing unit on board the target vehicle is arranged so as to operate with software substantially as set out in the flowchart shown in Figure 4.

4. System according to one or more of the preceding claims, characterized in that the computing unit on board the seeker is arranged so as to operate with software substantially as set out in the flowchart shown in Figure 5.

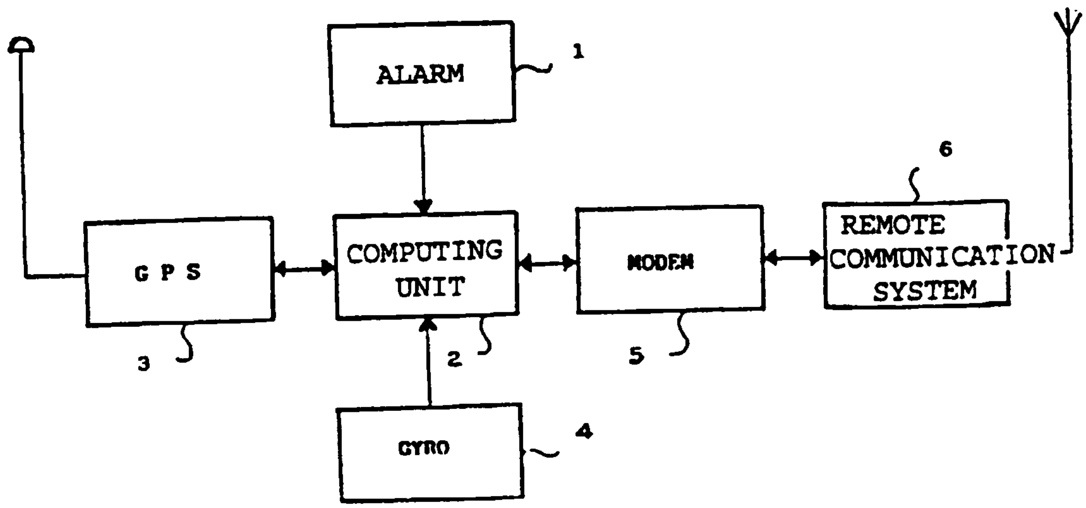

ALARM
1
6
REMOTE COMMUNICATION SYSTEM
G P S
COMPUTING UNIT
MODEM
3
2
5
GYRO
4

FIG. 1

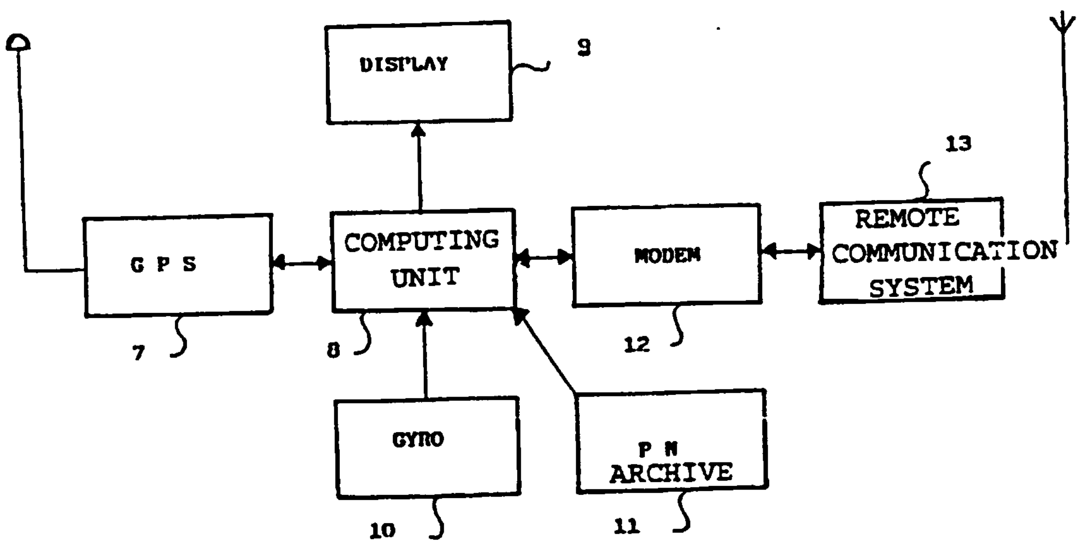

DISPLAY
9
13
G P S
COMPUTING UNIT
MODEM
REMOTE COMMUNICATION SYSTEM
7
8
12
GYRO
P N ARCHIVE
10
11

FIG. 2

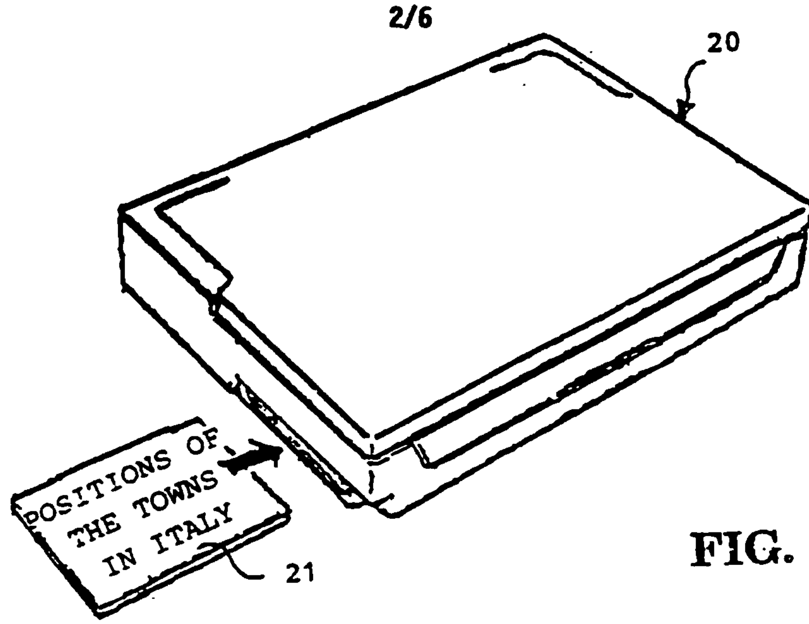

20
POSITIONS OF
THE TOWNS
IN ITALY
21

FIG. 3A

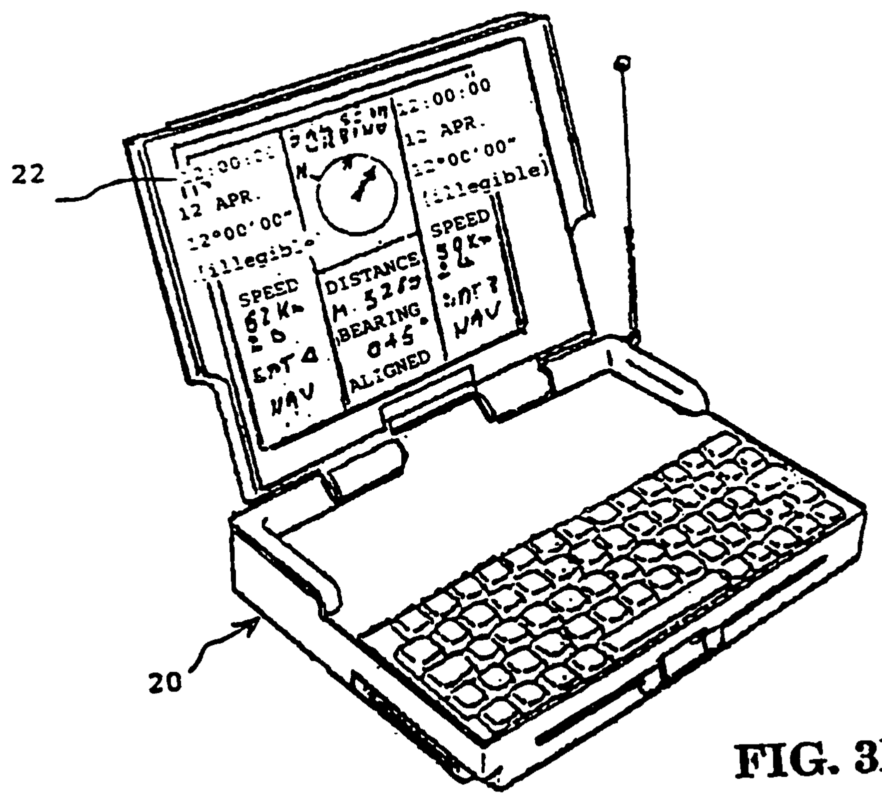

22
20
12 APR.
SPEED
DISTANCE
BEARING
ALIGNED
NAV

FIG. 3B

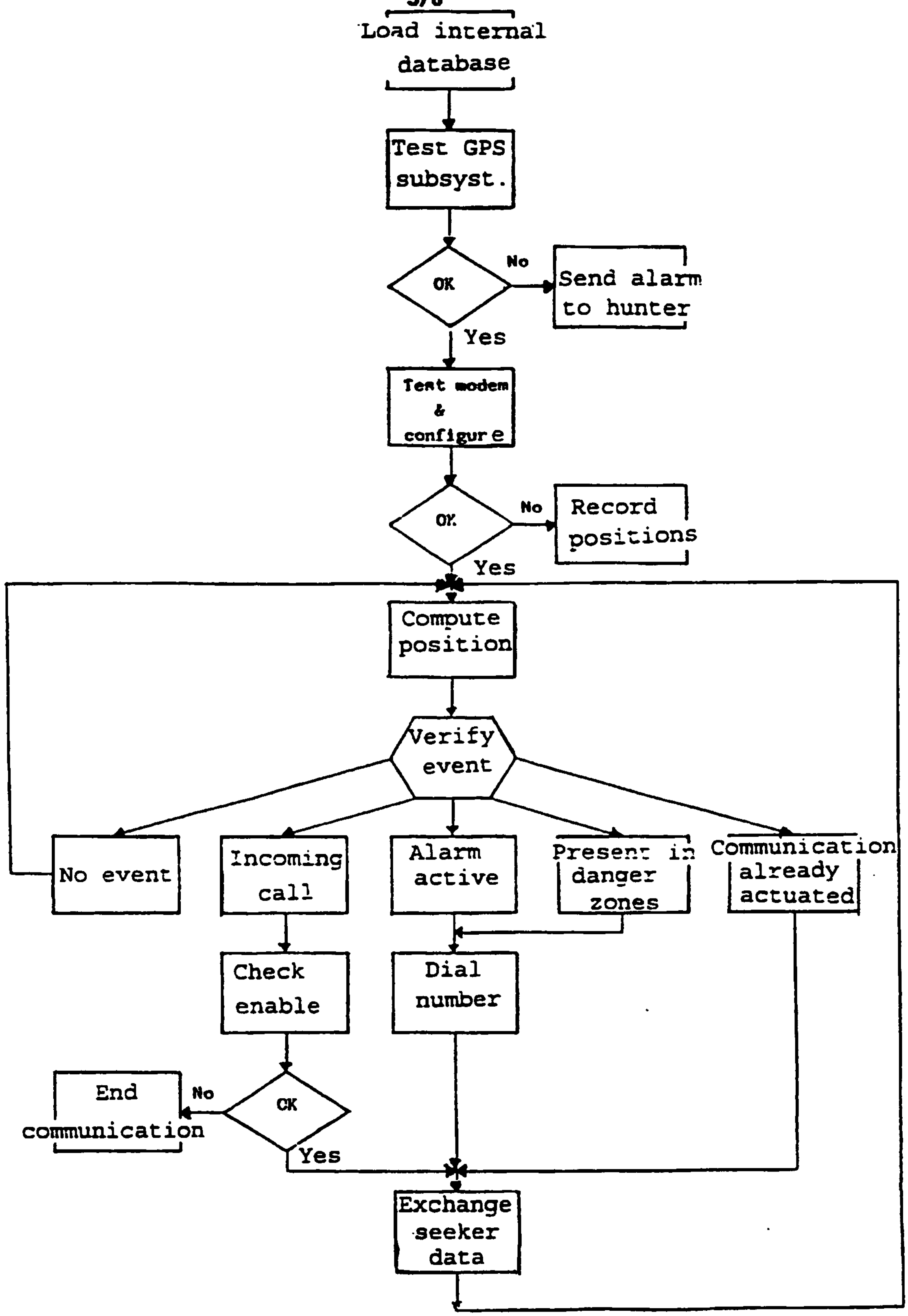
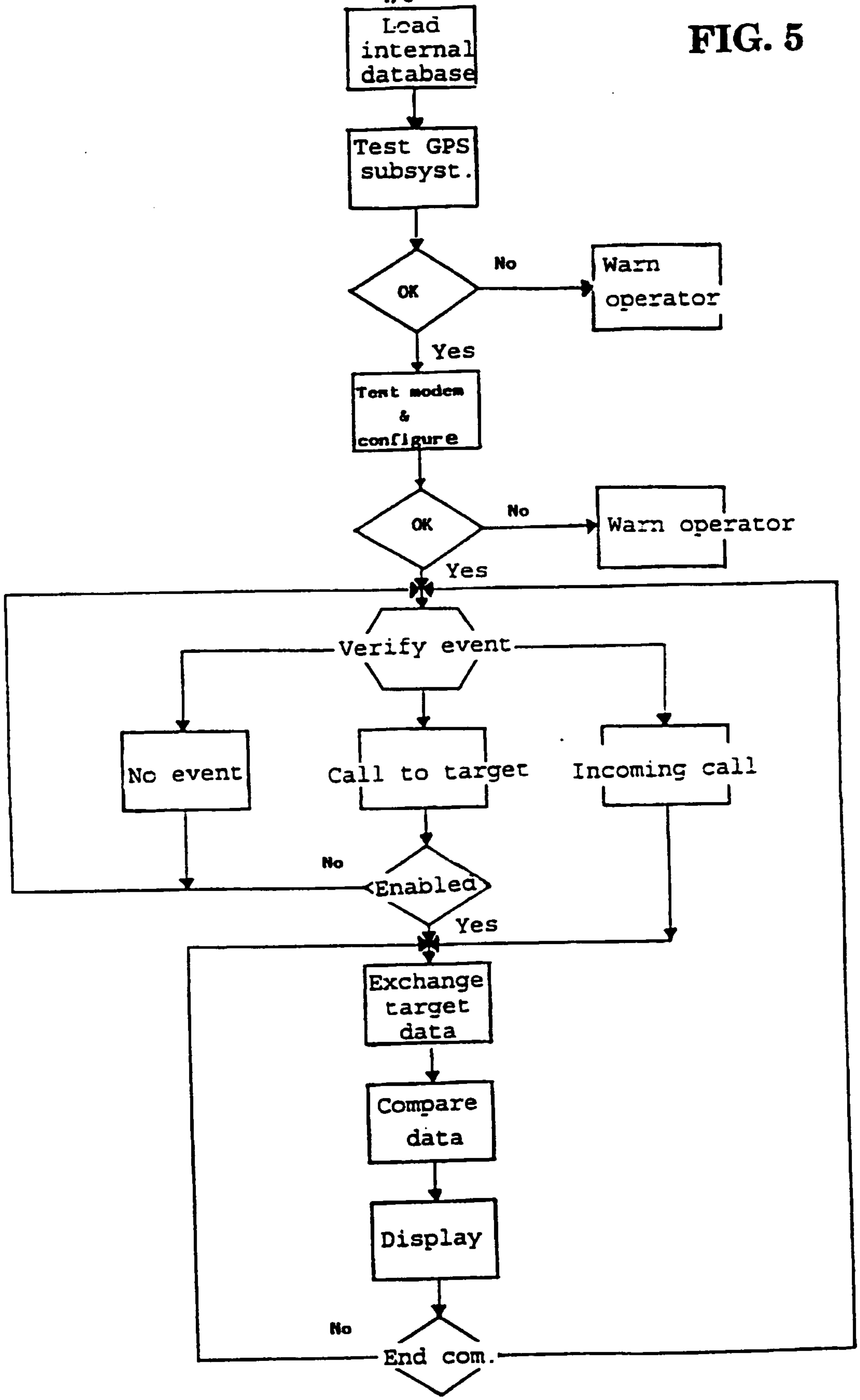
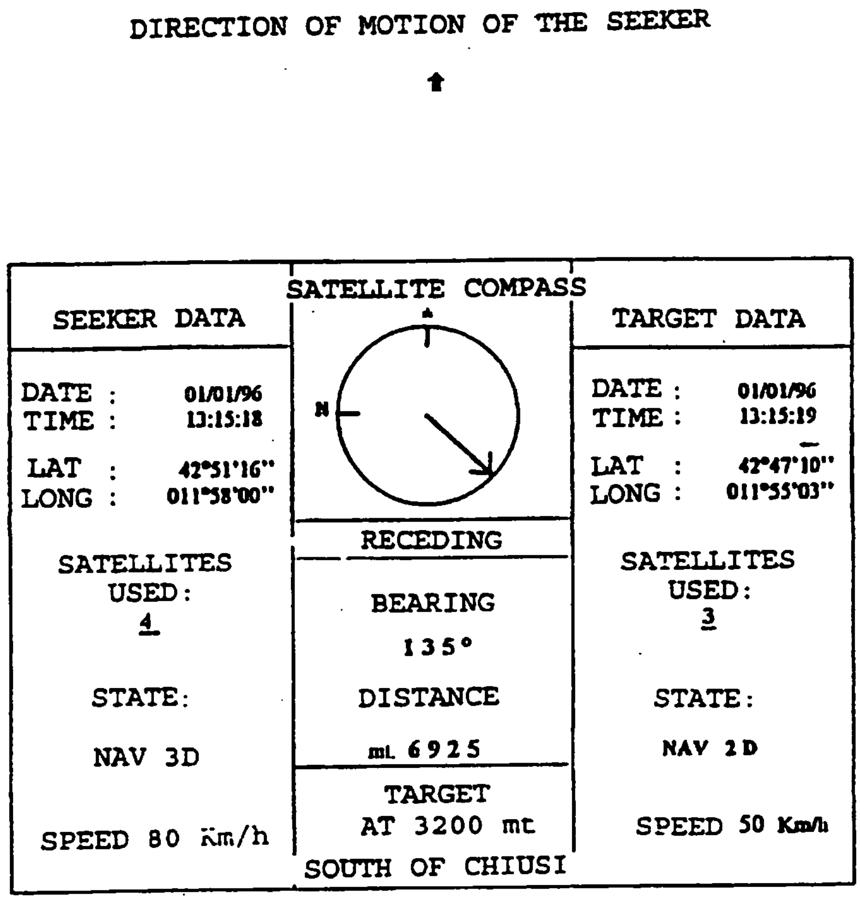

Load internal database
Test GPS subsyst.
OK
No
Send alarm to hunter
Yes
Test modem & configure
OK
No
Record positions
Yes
Compute position
Verify event
No event
Incoming call
Alarm active
Present in danger zones
Communication already actuated
Check enable
Dial number
End communication
No
OK
Yes
Exchange seeker data

FIG. 4

FIG. 5


Load internal database
Test GPS subsyst.
OK
No
Warn operator
Yes
Test modem & configure
OK
No
Warn operator
Yes
Verify event
No event
Call to target
Incoming call
No
Enabled
Yes
Exchange target data
Compare data
Display
No
End com.



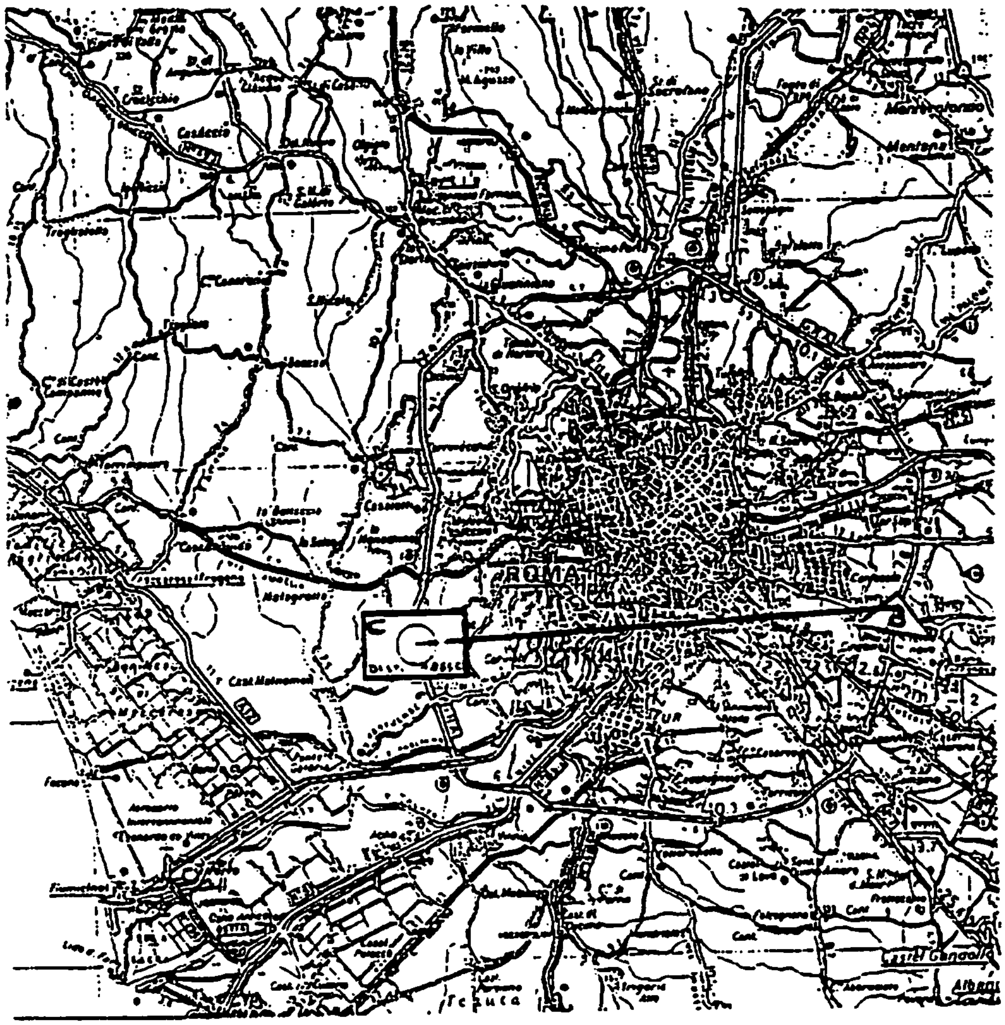
LEGEND

* indicates the direction of motion of the seeker
N indicates the direction of true North with respect to the seeker
↘ indicates the direction to be followed to reach the TARGET

BEARING is the angle between the direction * followed by the seeker and the direction ↘ in which the target lies

DETAIL OF THE SEEKER'S DISPLAY

FIG. 6



target position = B
seeker position = C

FIG. 7

scale 1:200,000
1 cm. = 2 km

INTERNATIONAL SEARCH REPORT

Inte   nal Application No
PCT/IT 97/00072

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 G01S5/14

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 G01S H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5 389 934 A (KASS) 14 February 1995 see abstract; figures 1,2 see column 2, line 34 - line 65 ---	1
Y	FR 2 670 002 A (LEROY) 5 June 1992 see abstract; figures 1-4 see page 7, line 30 - page 8, line 17 ---	1
A	US 5 418 537 A (BIRD) 23 May 1995 see abstract; claim 1; figures 3,5 ---	2
A	EP 0 519 630 A (SUMITOMO ELECTRIC INDUSTRIES,LTD.) 23 December 1992 see abstract; figure 1 see column 5, line 37 - line 57 --- -/--	1

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

1

Date of the actual completion of the international search	Date of mailing of the international search report
8 July 1997	23.07.97
Name and mailing address of the ISA European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Authorized officer Danielidis, S

INTERNATIONAL SEARCH REPORT

Inte nal Application No
PCT/IT 97/00072

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 94 12892 A (VOXSON INTERNATIONAL PTY.LTD.) 9 June 1994 see claims 1-4 -----	1

1

Form PCT/ISA/210 (continuation of second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/IT 97/00072

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		JP 7039960 B	01-05-95
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		DE 69204575 T	15-05-96
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		US 5307277 A	26-04-94
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		AU 5555294 A	22-06-94
		CA 2150757 A	09-06-94
		CN 1094557 A	02-11-94
		EP 0681704 A	15-11-95
		JP 8505469 T	11-06-96
		ZA 9309312 A	28-09-94